April 11, 2014

Mr. W. Grant Farrar
Corporation Counsel
City of Evanston
2100 Ridge Avenue
Evanston, IL 60201

RE: James Park, City of Evanston
Environmental Exploration Program Scope of Work and Cost Estimate
CS Geologic Proposal 13011602

Dear Mr. Farrar:

Pursuant to the request of Ms. Michelle Masoncup, Deputy City Attorney CS Geologic LLC (CSG) is providing an outline of the recommended scope of work for evaluating the presence of combustibe gas in the vicinity of the park. Prior to outlining the recommended steps, CSG is providing a summary of the pertinent observations from last week's initial phase of investigation.

I. Observations from Initial Investigations

As discussed in our conference call with Ms. Masoncup and Mr. Pirooz, elevated methane concentrations (approximately 85% by volume, 1700% LEL) was detected in gas probe GMP1 located in the southwest corner of the James Park area (Refer to Figure 1). The methane was detected in a sand seam at a depth of 49.7 feet below ground surface. Preliminary pressure measurements indicate approximately 155 inches of water column pressure at probe GMP1. No measureable methane concentrations were apparent at either GMP1A (completed in the bedrock adjacent to GMP1) or at GMP2A (completed at the top of bedrock in the northwest corner of the former compost facility).

Boring GMP3 was completed on Friday April 4, 2013 between probes GMP1 and GMP2 in order to help delineate the methane extent along the western property boundary. Boring GMP3 encountered nearly 40 feet of landfill materials (primarily ash and cinders) underlain by approximately 10 feet of stiff silty clay. A coarse grained sand seam was encountered at a depth of 50 feet. The groundwater level within this sand layer rose to 19 feet below ground surface. No evidence of any elevated methane concentrations were identified at GMP3 either within the fill or in the underlying soils. Due to the lack of methane observations, the saturated conditions and the deep extent of the fill materials, a decision was made to tremmie grout the boring with high solids bentonite grout, in order to minimize potential for groundwater flow between the fill material and the sand seam.

II. Proposed Supplemental Evaluation Steps

As discussed in the April 7 conference call, the following tasks are recommended to further delineate the nature and extent of the trapped gas identified at probe GMP1. Tasks are also proposed to help mitigate the potential explosive condition risks associated with the elevated methane concentrations and pressures observed at probe GMP1.

CS GEOLOGIC LLC 920 Cambridge Drive • Libertyville, IL 60048 • 847-804-6064 • craig@csgeologic.com

Short Term Characterization Steps

1. **Measure Gas Concentrations, Pressures, Flow Rate and Trace Gas Concentrations.** As discussed in the October 2013 project scope, it is recommended that probe GMP1 be sampled to characterize the potential source of the methane. Trace volatile organic constituents such as freon, vinyl chloride, or lite aromatic constituents might be useful in characterizing the source of the gas and aid in determining whether the gas fingerprint is consistent with the gas reported at Boring B-11 at the O'Brien Treatment Plant (refer to Figure 1 for gas probe B-11 location). The gas chromatographic characterization might also be used to rule out other potential sources such as drift gas from decay of organic materials in the soil or gas derived from the biodegradation of naturally occurring oil deposits found in the Silurian Dolomite. Similarly, the isotopic concentrations of the gas (tritium and C^{14}) will be monitored to date the age of the combustible gas. This information is anticipated to help define whether the gas is derived from the landfill which is approximately 50 to 75 years old as opposed to bituminous material in the Silurian bedrock (450 million years old).

   As part of the sampling effort, it is also recommended that the gas pressure and flow rate be quantified at GMP1. This data would be useful to evaluate appropriate gas destruction alternatives if pilot gas extraction studies or longer term extraction options are evaluated (note the combustible gas pressures and flow rates may vary as a function of barometric pressure, therefore it is necessary to characterize these properties under varying weather conditions).

   Currently, $5,294 has been budgeted for geochemical characterization of the gas (refer to October 25, 2013 proposal). However, the proposal anticipated analyzing gas samples collected from 3 locations. Currently, only probe GMP1 has been demonstrated to contain significant combustible gas concentrations. If only the one location is sampled the costs are likely to be approximately $2,200.

2. **Evaluate Potential Utility Corridor Pathways and Sources of the Combustible Gas** The City Public Works and Utilities Departments should evaluate whether any deep utilities exist in the vicinity of the southwestern portion of James Park which could act as a migration pathway for the trapped gas. While it is not anticipated that the City has utilities that have been installed to the depth where the combustible gas was encountered (approximately 50 ft), the available utility records should be reviewed to confirm that no obvious vertical pathways for gas migration exist. CSG, recommends that the City periodically monitor utility catch basins, access manways etc. in the James Park area for the presence of combustible gas. Because barometric pressure fluctuations can greatly affect the combustible gas pressures, it is recommended that monitoring emphasize periods of low or falling barometric pressure.

   The Metropolitan Water Reclamation District Deep Tunnel access shafts installed near boring B-16 (Refer to Figure 1) may act for a pathway for gas to migrate either into or from the bedrock. Potential exists for methane gas to migrate to shallower depth intervals behind the access shaft lining. As shown in the June 13, 2013 TetraTech Inc. report, the tunnel shaft located just south of the Skokie Swift Train line is located at a high point on the bedrock surface (Refer to Figure 2 Boring B-16 area) which could act as a natural stratigraphic trap for gas generated from the biodegradation of naturally occurring oil in the Silurian Bedrock. CSG recommends that the City

conduct a Freedom of Information Act (FOIA) request regarding any information pertaining to air monitoring results and leakage of groundwater within the deep tunnel access shafts located west of James Park. It is suspected that the sand seam in which the combustible gas has been encountered at GMP1 may be (or may have been) dewatered due to deep excavations such as the tunnel shaft.

While the landfilling operations are reported to have ceased during the early 1960's, there may be some surviving workers who are familiar with the landfill operations. Drilling investigations completed by TSC (1999) and CSG (2014) indicate that most of the fill materials were burned. The workers should be interviewed to determine whether there were any areas of the clay pit where large quantities of putrescible (biodegradable or methane generating) materials may have been placed when open burning could not be accomplished (i.e., during very windy or rainy periods when burning was not feasible). If any useful information can be gained, these areas of the landfill should be investigated to assess whether heterogeneous conditions in the waste result in areas of high gas production potential.

This historical survey task is assumed to be conducted internally by the City. CSG is available to help interview any individuals with knowledge of the filling procedures. No cost estimate is provided for this task, since it is unknown whether any individuals can be located with knowledge of the former clay pit landfilling operations.

3. Install Additional Gas Probes to Characterize the Gas Extent and Potential Risks to Residents

Because the trapped gas is under considerable pressure it is capable of migrating considerable distances through granular soil deposits that have been identified in the glacial and lacustrine deposits. Little or no information is available which defines the geology around the perimeter of the former clay pit. As such, the existence of potential gas migration pathways toward residential areas can neither be confirmed nor ruled out. At present, the potential risks of fire or explosion appear to be mitigated by the fact that the gas is trapped beneath nearly 50 feet of predominantly clay soil deposits. Thus, the potential for vertical migration of the gas into structures where explosive conditions could develop appears to be limited by the relatively thick clayey soils which act as a barrier. Additional gas probes are necessary to define the site geology (primarily the existence of sand seams which could act as migration pathways) and to define the lateral extent of the combustible gas migration. Geologic information collected during the probe installation is also necessary to assess the continuity of the clay layer that acts as a barrier to vertical gas migration. As such, an evaluation of the geologic conditions and extent of combustible gas migration is recommended in order to assess potential risks to area residences, schools and businesses.

Finally, the saturated sand layer conditions identified at probe GMP3 (i.e., groundwater head approximately 30 feet above the sand layer) suggest that the relatively high combustible gas pressures exhibited at probe GMP1 may be the result of hydrostatic pressure acting on the trapped gas (i.e., groundwater pushing on gas trapped in the sand seam) rather than pressures generated at the source of the gas emission. The proposed investigation is designed to identify the existence of these groundwater conditions.

CSG recommends that the additional gas migration characterization be conducted using a cone penetrometer testing (CPT) rig. Utilities extending along the south side of James Park (directly north of the Skokie Swift Line) embankment present challenges that are not easily overcome by conventional drill rigs. For instance the need to maintain appropriate setback distances from the 72 inch diameter storm and sanitary sewers require that the probes be installed in close proximity to the overhead electrical lines. Due to the steel rig derrick and drilling rods, it is not possible to drill as close to the overhead wires as is necessary to maintain the setback from the sewers. The CPT rig is enclosed in a box truck (approximately 11 feet high) that does not need to elevate rods near the overhead power lines. Thus, the work can be conducted in close proximity to the electric power lines in a safe manner.

As shown in Attachment A, the CPT rig provides a continuous profile of the soil conditions (clay vs sand and silt content) based on the ratio of cone tip resistance to sleeve cohesion. The rig tooling is also equipped with a conductivity sensor and a pressure transducer. Because gas has a lower electrical conductivity than water, the presence of low electrical conductivity pressurized zones provide real time evidence of gas migration zones. Gas probes can then be installed within the discrete soil intervals that are acting as potential migration pathways. The CPT rig is capable of completing approximately 200 ft of continuous sampling and probe installation (3 to 4 probes a day assuming a 50 -55 ft probe installation depth), whereas the drill rig is capable of approximately 50 ft, or one probe installation per day. Finally, the CPT rig does not generate drill cuttings and because the workers are enclosed in the box truck they are not highly visible to individuals utilizing the park or the surrounding areas. Contractor information on the CPT rig is presented in Attachment A.

As shown in Figure 1, CSG proposes that the perimeter of the park be evaluated by CPT testing at 10 additional gas probes (GMP4 – GMP13) installed at 400 to 500 ft intervals around the perimeter of the park. It is anticipated that ¾ inch diameter gas probes would be installed at locations where combustible gas charged sand seams are encountered or in units where gas might potentially migrate. As such, it is unlikely that all ten of the proposed locations would need to be instrumented with gas probes.

Once installed, the gas probes would be utilized to monitor the gas concentrations and pressures in the sand layer. The gas probes could also provide an observation point to assess the effects of any efforts to mitigate potential gas migration by extracting gas from the sand seam (refer to Task 4).

Assuming that each of the 10 CPT soundings would be completed to a depth of approximately 55 feet below ground surface and that half of the locations would be instrumented with ¾ inch inside diameter (ID) gas probes, it is estimated that the CPT contractor costs would be approximately $16,000 to complete the investigation. It is anticipated that the investigation could be completed in approximately 3 to 4 days. Field geologist costs for documenting the investigation, clearing utilities and relaying information to the City would add an additional $5000 to the characterization/probe installation program costs (including equipment costs, truck, photoionization detector, combustible gas meter, etc.). Thus, the total costs for the nature and

extent field characterization around the perimeter of the former clay pit are estimated to be approximately $21,000.

4. **Probe Monitoring**

Once the probes are installed, CSG will conduct two rounds of combustible gas monitoring of the probes using a Landtec GEM 500 multiple gas meter. The concentrations of methane, carbon dioxide, oxygen and balance gas (primarily nitrogen) will be recorded at each of the monitoring probes. Groundwater elevations, if any will be monitored and static pressure measurements will be recorded from the sealed probes. Brief measurements of gas flow rates would also be obtained using flow metering equipment. The gas monitoring data will be utilized to assess the subsurface gas concentrations, pressures, and flow rates. The measurements would also evaluate the variations in these parameters as a function of atmospheric barometric pressure fluctuations.

The costs of the two rounds of gas monitoring including the necessary equipment (Landtec GEM 500 multiple gas meter, fittings, dial pressure gages, etc) is $1,400.

Longer Term Corrective Measures/Evaluation Steps

5. **Pilot Gas Destruction Testing**

Based on CSG's experience, combustible gas migration episodes such as that observed in the southwest corner of James Park are nearly always mitigated in the same manner. The gas is generally collected and destroyed by either combustion or thermal oxidation equipment. Because gas probe GMP1 possess high methane concentrations (85 % by volume) under considerable pressure (approximately155" H_2O) it appears that the probe is capable of maintaining a relatively sustained flow rate. It is recommended that either an internal combustion engine (ICE) or a thermal oxidation unit (i.e. flare) be mobilized to the site to destroy the gas while minimizing air emissions. Equipment available from commercial vendors is capable of treatment efficiency of greater than 99%. Because the gas may contain trace concentrations of volatile organic constituents which are considered toxic, the thermal destruction or internal combustion of the gas is preferred (and generally required by applicable air regulations).

Regardless of the source of the gas (i.e., derived from on-site vs offsite sources), the flaring of the gas is recommended to mitigate potential risks associated with the high pressure combustible gas in the proximity to residences, schools and businesses. The flaring of the gas provides a means to reduce the gas pressures which in turn helps reduces the possibility of the gas migrating into a building where an explosive situation could develop. Furthermore, the monitoring of gas flow rates, concentrations and pressures during the course of extraction provides a useful means of evaluating the volume of gas present in the subsurface and it provides a means of potentially identifying the source of the gas. Shifts in the gas concentration during the extraction process (i.e., increasing CO_2 concentrations) may provide important clues to the origin of the gas (i.e., landfill gas vs. biogenic gas from petroleum biodegradation from offsite areas).

Based on preliminary information, it is anticipated that the pilot gas extraction test would consist of extracting gas directly from probe GMP1 in the southwest corner of James Park. Based on

preliminary flow information, it is believed that the 2 inch diameter probe is capable of sustaining gas flow that would be destroyed using either an internal combustion engine or a thermal oxidizer (this assumption would be further quantified by the testing proposed in Task 4). The decision on the appropriate destruction technology would be determined based on an evaluation of the sustainable flow rates and BTU content of the combustible gas stream. CSG proposes that additional flow testing be conducted to evaluate these properties (refer to Task 4), so that the optimal pilot test equipment can be leased for the pilot test.

Based on discussions with PRO-Act Environmental Services of Ludington Michigan, a variety of 4 cylinder, 6, 8 and double 8 cylinder ICE devices are available that can handle flow rates up to a maximum of 200 cubic feet per minute (CFM). Thermal destruction units (flares) are also available for rental to address a variety of flow rates. Based on discussions with Pro-Act, the monthly cost for an ICE gas destruction unit would range from a low of $3,000/month for a 4 cylinder model (maximum flow rate of 40 CFM) to $8000/month for a 8 cylinder model (maximum flow rate of 200 cfm). Mobilization/Demobilization of the equipment would cost approximately $4000 (lump sum). Finally, a technician would cost approximately $1000 a day. The technician might could be contracted for the duration of the pilot test or could be used to train site personnel (city employees, contractors etc.) on the equipment operations. Assuming a week of training, the technician costs would be approximately $7000. Thus, assuming City employee involvement in the operation of the ICE system, the costs for the first month of operation might be approximately $16,000 (assuming 6 cylinder model) plus any internal labor costs incurred by the City. The cost for subsequent months would be approximately $5000/month plus labor costs (labor costs potentially internalized by the utilization of City employees). The cost for a thermal oxidizer flare system capable of managing flows up to 200 cfm would be similar to the 6 cylinder ICE Unit (i.e., $5000-$6000 month) and similar start up/mobilization (assume $11,000 for mobilization of equipment and 1 week of technician time to train on-site personnel).

In addition to the flow rate and BTU considerations, the selected gas destruction technology might also depend on authorizations from IEPA Bureau of Land and Bureau of Air. Air emissions during the pilot test are anticipated to be negligible, on the order of a single automobile thus, the approvals for the pilot study should not be overly complicated. Authorizations have been granted for similar pilot testing programs at the Mallard Lake Landfill in Hanover Park. However, in the Mallard Lake case, the applicant already had a Bureau of Air permit for the facility. Additional effort may be required if the IEPA deems that a new source air permit is required. Should the City choose to implement these steps (or similar procedures) to mitigate the combustible gas concentrations and pressures, then CSG recommends that IEPA be contacted about the appropriate permitting/authorization steps. It is likely that some type of focused Site Investigation Report describing the preliminary nature and extent of the combustible gas will be required along with a focused corrective action plan (or pilot test plan).

Because the filling of the clay pit at the James park site predates the Illinois EPA Solid Waste Permitting program, it is likely to fall between sections of the Agency. Potentially, the work might be addressed through the Site Remediation Program (35 IAC 740) in which case the authorization to flare the gas might be gained by submitting a focused site investigation report and corrective action/pilot study plan (refer to 35 IAC 740.430). The IEPA Site Remediation reviewer would then have to involve appropriate Solid Waste Management Section and Bureau

of Air reviewers to secure approval for the pilot test program. Generally, IEPA requires that corrective action plans which include design elements (rather than just field condition characterization) be submitted by an Illinois Licensed Professional Engineer. Should the City wish, CSG could provide referrals for professional engineers with experience designing and operating landfill flare systems and/or ICE units. Unfortunately, until this process is discussed with IEPA, it is difficult to estimate the costs for securing any permits (if any) necessary to run the pilot gas extraction test. As such the development of a cost estimate for this task is dependent on IEPA notification and subsequent discussions.

6. Pilot Extraction Test Gas Monitoring and Data Interpretation

As previously mentioned, the goals of the pilot gas extraction testing is 1) to reduce the combustible gas concentrations and pressures and thereby reduce potential risks to the surrounding population; 2) to evaluate the volume of gas trapped in the subsurface; and 3) to evaluate the source of the methane. In addition to determining the radius of influence of the extraction well, monitoring the changes in pressure and gas concentrations during the course of gas extraction can provide useful source identification information. Currently the gas is composed of high concentrations of methane with balance gas (primarily nitrogen and possibly trace VOC concentrations). Landfill Gas is typically a relatively equal mixture of methane and carbon dioxide. The methane concentrations may increase in the gaseous phase if CO_2 is removed by water washing (CO_2 has a higher aqueous solubility and therefore may go into solution, thus concentrating the methane in the gaseous phase). If a landfill source of gas migration exists and is ongoing, a gradual increase in CO_2 concentrations would be expected as the water washed gas is removed from the formation and more recent gas is drawn from the landfill. Conversely a source of gas derived from biodegradation of petroleum in the bedrock would be anticipated to consist of predominantly methane with trace concentrations of cyclic aromatic compounds. Mixture of this type of biogenic gas with atmospheric air (as might happen if air were drawn into the formation from the deep tunnel access shafts) could result increased nitrogen and oxygen concentrations. Therefore, it is anticipated that monitoring the gas probe concentrations for changes in concentration during the course of the extraction might provide telling information on the source of the methane.

The conditions observed at GMP1 in the southwest corner of James Park appear conducive for gas to migrate considerable distance (i.e. thin confined sand seam, with considerable gas pressure). Similar conditions in DuPage County resulted in gas migrating approximately 2/3 of a mile from the source. However, these conditions may also be conducive to extracting the gas from the formation from relatively few extraction wells (i.e., relatively great radius of influence, requiring fewer extraction wells).

CSG proposes to monitor the probe concentrations, pressures and groundwater levels on a weekly interval during the course of the extraction pilot test. It is anticipated that the pilot test will likely be terminated when the gas pressures have been sufficiently reduced that groundwater flows back into the sand seam and blinds off the flow of gas to GMP1. For cost estimation purposes it is assumed that the pilot test will continue for a five week period. The field costs associate with the gas monitoring (personnel and equipment) is approximately $750/week or $3,750 assuming a 5 week monitoring period. If charting and/or gas mixing analyses are required, additional time could be required to assess the data. As such, total costs for field data

collection, analysis of the probe data and analysis of the gas extraction data are approximately $8,500. The need for follow up reporting to IEPA would be determined based on the preliminary discussions with IEPA.

III. Summary of Estimated Costs

Based on the preceding discussions, the following Table summarizes the estimated costs for the Tasks that have been summarized. A more detailed cost estimate can be provided once IEPA has been contacted and the appropriate regulatory process is defined.

Task	Objective	Estimated Costs
1. Gas Probe Characterization	Identify source of gas and provide data to evaluate appropriate mitigation steps.	$5,294 currently budgeted*
2. Evaluate Utility corridors as potential migration pathways. Historical Survey of Landfill.	Characterize potential risks to residents and businesses. Identify landfilling practices that might contribute to methane generation.	To be performed by City personnel.
3. CPT installation of Gas Probes.	Define site geology, and extent of combustible gas migration on-site. Provide data to assess feasibility of gas removal.	$21,000 for 10 probes shown in Figure 1 (3-4 days of site characterization)
4. Two rounds of Gas Monitoring	Characterize extent of gas migration under varying barometric pressure conditions.	$1400 (2 rounds of monitoring)
5a. Pilot Test Reporting/Permitting	Obtain necessary State approvals for pilot remediation destruction testing.	Unknown until notification is made and situation is discussed with IEPA. Assume $8000-$10,000
5b. Pilot Gas Destruction Testing	Reduce risk of migration, characterize volume of gas present, evaluate source of gas migration.	$11,000 lump sum mob/demob and training. $5000-$6000/month assume 1 month test
6 Extraction Test Monitoring/Documentation of Results	Assess the volume of trapped gas, identify source of release, identify whether ongoing gas releases are occurring, assess whether pilot test should be continued as final remedy.	$8,500
	Estimated Additional Costs^	$58,000

*Gas characterization budget of $5,294 has already been approved, refer to October CSG proposal.

^ Cost estimate does not include previous characterization proposal that was previously approved. Cost estimate for permitting and reporting is subject to change depending on regulatory agency input into process. The pilot extraction test duration is assumed to be 1 month. The test may be extended (at additional costs) if the results indicate that risks are significantly mitigated by the gas destruction activities. Cost estimate assumes that City employees are utilized to operate the oxidizer or ICE system.

IV. Summary

Preliminary information obtained from probe GMP1 suggests that the combustible gas concentrations appear similar to those reported at the Metropolitan Water Reclamation District O'Brien Treatment Plant Probe B-11. While the gas is encountered at a shallower depth (in a sand seam at a depth of approximately 50 ft. rather than at the top of bedrock), the source of the combustible gas is not fully understood at this time. To date, soil borings completed in the landfilled areas of James Park have not indicated similarly elevated methane concentrations and pressures. However, it is possible that the methane has been concentrated by contact with groundwater which may have reduced the carbon dioxide concentrations in the gaseous phase. The groundwater contact mechanism may also explain the relatively high pressures observed at probe GMP1 (i.e., groundwater is pushing on the gas trapped in the sand seam). It is also possible that the methane may have migrated into the sand seam from greater depths (i.e., from the bedrock).

Additional characterization tasks (monitoring and probe installation) are recommended in order to gain a better understanding of any human health and safety risks that might be presented by the trapped combustible gas. Finally, pilot studies are recommended to remove and destroy the combustible gas in order to mitigate the potential risks to residents and to gain a better understanding of the nature of the problem.

V. Limitations

This is a preliminary draft. It has been prepared based on preliminary information and assumptions. The opinions expressed herein are subject to change as additional information becomes available or is clarified.

VI. Closing Remarks

CS Geologic appreciates the opportunity to assist the City of Evanston. Please do not hesitate to call if you have any questions or comments on tasks which have been outlined on the preceding pages.

Sincerely
CS Geologic LLC

Craig S. Rawlinson

Craig S. Rawlinson, P.G.
Principal Hydrogeologist

Attachment A

Cone Penetrometer Testing Background Information

STRATIGRAPHICS
CPT geotechnical and geo-environmental exploration

Services

PENETROMETER SOIL EXPLORATION SYSTEM

STRATIGRAPHICS specializes in Cone Penetration Testing penetrometer exploration services, typically for geo-environmental and geotechnical studies. The Cone Penetration Testing penetrometer method is minimally intrusive, using a high capacity hydraulic ram to directly push small, 1.5 to 2.5 inch diameter probes into the ground without drilling a borehole. Electronic strain gage load cells mounted inside the penetrometer provide a high resolution, continuous record of the soil response to penetration. ASTM D5778 defines Cone Penetration Test (CPT) standards. In addition to CPT penetrometers with various additional sensors, we also deploy penetrometer (direct-push) soil, soil gas and groundwater samplers. ASTM 6001 describes geo-environmental applications of direct-push samplers. One of our papers is used as a reference in this document.

CPT data can be used for the evaluation of local geotechnical, hydrogeological, and qualitative geochemical characteristics. Cone Penetration Testing is more economical and quite often more accurate than typical borehole drilling and sampling because of high productivity, little or no generation of exploration derived wastes, very high data density, excellent repeatability, good practical and theoretical understanding of test results and limitations, and relative independence from operator errors. Real time display and recording of CPT data allow immediate evaluation of subsurface conditions. Well documented and widely accepted techniques allow rapid, high resolution (about 1 inch) definition of local stratigraphy. Superior evaluation of the lateral continuity of layers is routine with CPT data. Data are also typically evaluated for geotechnical parameters such as soil types, relative density, friction angles, undrained shear strengths, and equivalent SPT blowcounts.

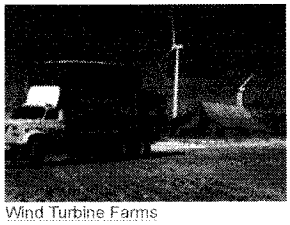
In addition to Cone Penetration Testing penetrometers, we deploy penetrometer (direct push) samplers to sample groundwater, soil and soil gas for use in analytical testing. Direct samples confirming indirect measurements are quickly, reliably and economically obtained. We install small diameter wellpoints and piezometers for longer term monitoring purposes. We also can install up to 3 inch diameter micropiles for specialized foundation construction projects.

The most common and productive deployment platform for Cone Penetration Testing is a specially designed, ballasted truck mounted rig. These are used to house, transport and deploy the two of STRATIGRAPHICS penetrometer ssytems – one 24 ton, and one 30 ton. The rigs' ballasted weight resists the thrust of the hydraulic ram.

Penetrometer sounding depths deeper than 100 feet can be regularly achieved at many sites. We have achieved depths in excess of 200 ft (+60 m) with our 30 ton rig and over 180 ft (55 m) with our 24 ton rig in the glacial soils of the Midwestern USA. Very dense sandy soils with SPT of up to as much as 80-100 blows/foot might be attempted to be explored using penetrometer methods. Our CPT production record is 1300 linear feet of CPT in one day. STRATIGRAPHICS regularly achieves rates of 400-600 ft of CPT per day.

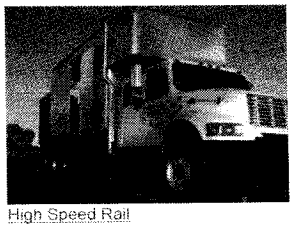
STRATIGRAPHICS also performs Cone Penetration Testing with a rubber tracked ATV, provides CPT for overwater projects using a modular system, and has light weight systems for very soft sediment studies.

Our Projects



Wind Turbine Farms

Levees



High Speed Rail

More Projects

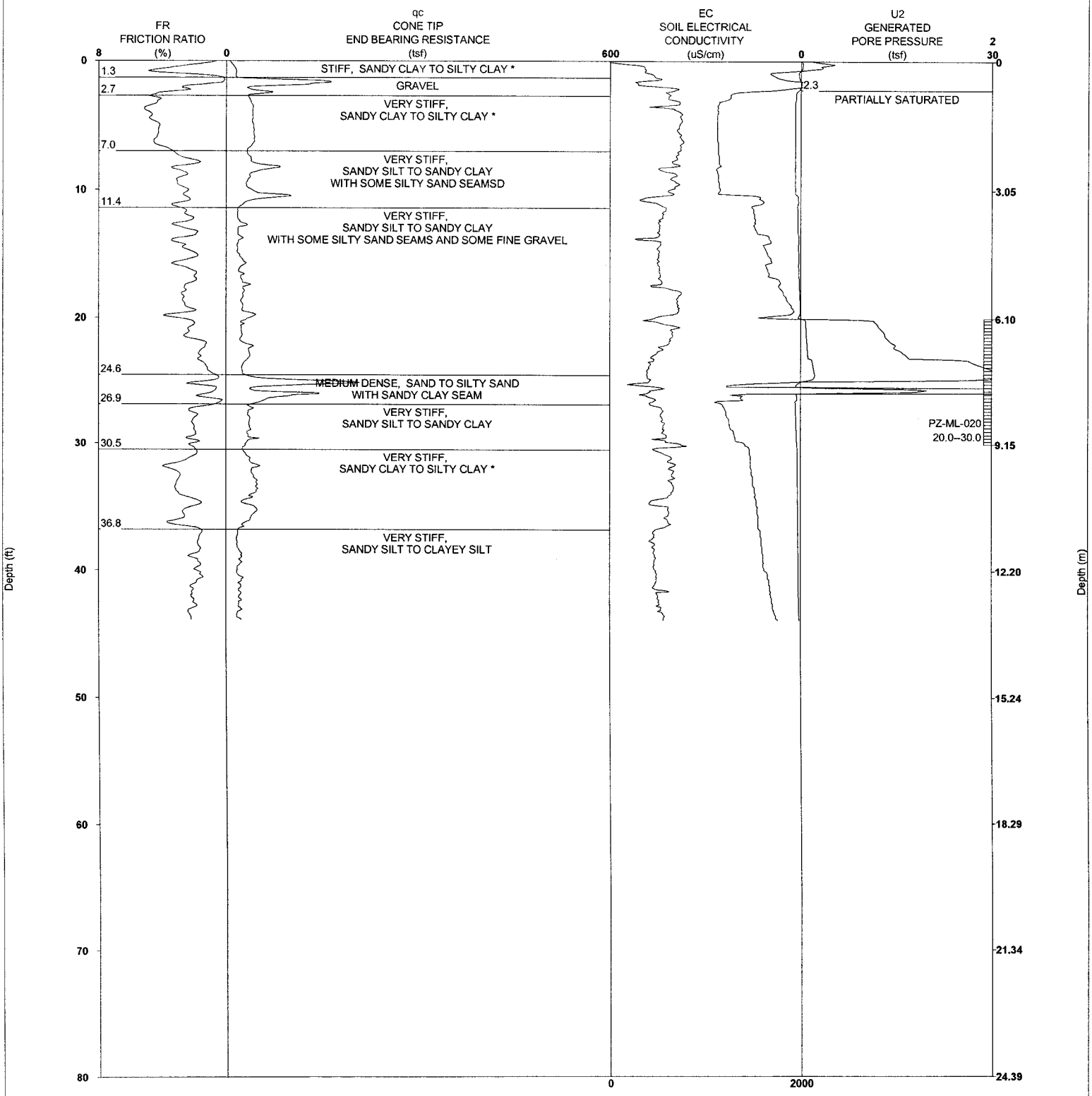
STRATIGRAPHICS
26798 County T
Hilpoint, WI 53937
toll-free number **1-888-790-CPTU (2788)**

Summary of CPT Characterization of Gas Migration

STRATIGRAPHICS routinely performs CPTU-EC (Piezometric CPT with soil Electrical Conductivity measurements) during nearly all its exploration projects including both geo-environmental and geotechnical applications. The CPT soil resistance measurements are highly indicative of soil types – permeable sands versus impermeable clays. Seams of sands within a glacial clay till as thin as about 2 inches can be detected with the CPT soil resistance measurements. The CPT piezometric measurement extends thin seam resolution to about one inch – but allows the measurement of fluid pressures within the seam – gas or groundwater. The advance of the CPT penetrometer is temporarily paused when a thin, potentially gas – charged seam is encountered, while the piezometric response is recorded. Most typically, if gas-charging (versus groundwater) is present, piezometric pressure response in the seam is nearly instantaneous. In contrast, when only groundwater saturation is present, the piezometric response is dampened due to the much lower soil permeability to water flow as compared to gas flow. Finally, STRATIGRAPHICS then evaluates the soil Electrical Conductivity response within the seam. If gas charging is of high enough magnitude, very often groundwater has been expelled from the seam due to gas over-pressure, and the seam is relatively dry and of low electrical conductivity, since groundwater is the most conductive portion of soil. Dry sands have little electrical conductance. We log the piezometric pressure within the sand seam – this gives the gas (or groundwater) pressure within about +/- 1 psi.

After the CPTU-EC sounding is completed to depth during methane gas migration studies, STRATIGRAPHICS most often installs a ½ to ¾ inch PVC gas sampling port within the formation. The PVC screen and riser is carefully sealed to isolate sand seams which are to be measured. STRATIGRAPHICS can install up to three completions (sample zones) within one installation should multiple sand seams be encountered at a location. If remediation is the goal, STRATIGRAPHICS often installs long ¾ PVC screens to most efficiently vent encountered gas.

CPTU-EC LOG WITH LITHOLOGIC EVALUATION CP-ml019



Latitude: 41.96581 Longitude: -88.13919

PROJECT NAME:Mallard Lake Landfill
PROJECT NUMBER:08-110-170

STRATIGRAPHICS

R1 DATE:11/21/2008 TIME:12:46 PM
SOUNDING NUMBER:CP-ML-019

CPT Data

Job Number	1907-0079	CPT Number	CP-43	Location	Hanover Park-IL
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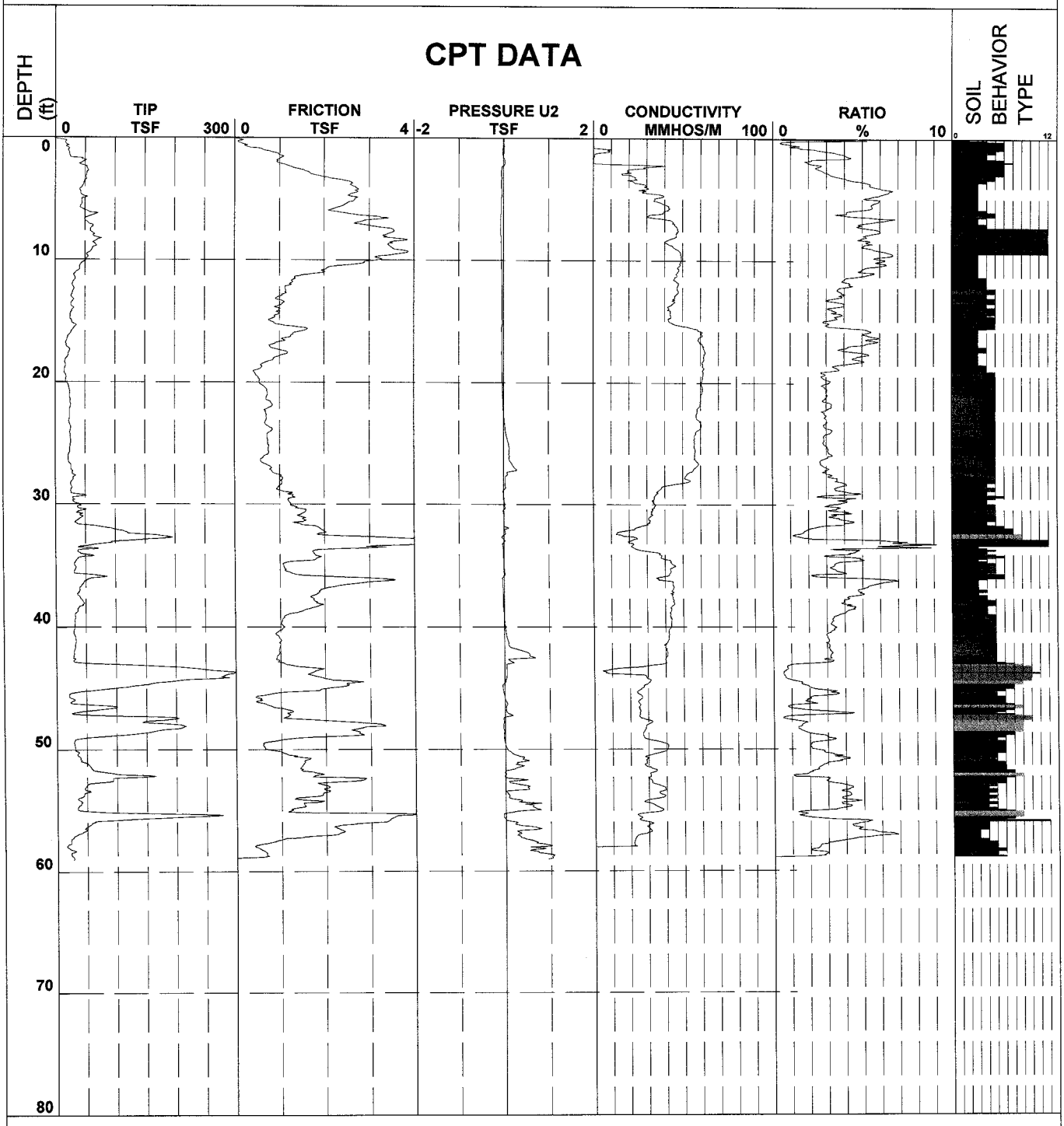
Client		Elevation		Water Table	



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Robertson et al. 1986 * Overconsolidated or Cemented